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(71)Applicant : SANKYO SEIKI MFG CO LTD

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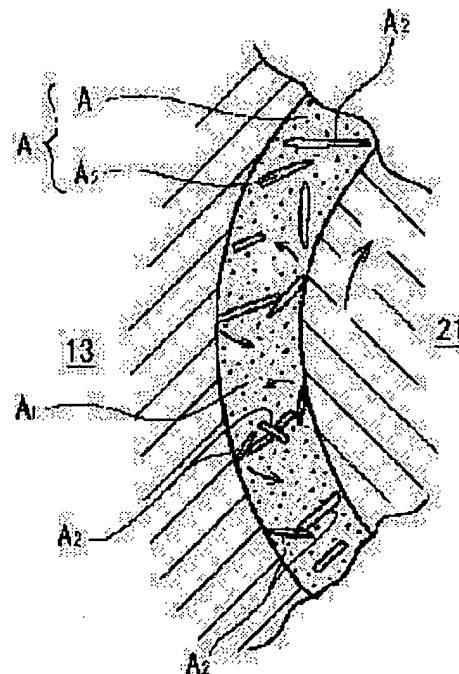
(72)Inventor : HAYAKAWA MASAMICHI

## (54) DYNAMIC PRESSURE BEARING, AND MANUFACTURING METHOD THEREOF

## (57)Abstract:

PROBLEM TO BE SOLVED: To simply and miniaturize a dynamic pressure bearing, and to obtain the excellent dynamic pressure characteristic.

SOLUTION: Conductive pieces formed of flakes which are residual powder produced when machining a flexible bearing sleeve 13 are dispersed in the lubricating fluid which is generally used, inexpensive and excellent in bearing characteristic, the lubricating fluid conductive thereby is poured in a bearing space between a rotary shaft 21 formed of a conductive material and the bearing sleeve 13, and the rotary shaft 21 side and the bearing sleeve 13 side are electrically connected to each other by one or a plurality of conductive pieces P formed of flakes which are residual powder of the bearing sleeve 13.



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## CLAIMS

[Claim 1] The shank material and bearing member which have been arranged so that relative rotation may be carried out, carrying out field opposite mutually, The dynamic pressure bearing surface formed in both the opposed faces of this shank material and a bearing member, respectively, In the hydrodynamic bearing equipment which has the dynamic pressure generating slot of both [ these ] the dynamic pressure bearing surfaces established in one side at least, and the lubrication fluid which is poured in into the opposite clearance between said both dynamic pressure bearing surfaces, and generates dynamic pressure according to a pressurization operation of the above-mentioned dynamic pressure generating slot While being formed with a conductive ingredient and formed from the quality of the material of said shank material and a bearing member in which the member of the one side of these shanks material and the bearing members has flexibility rather than the member of the other side, respectively Hydrodynamic bearing equipment characterized by distributing the conductive split which has flexibility comparable as the quality of the material which has the above-mentioned flexibility so that the lubrication fluid concerned may equip said lubrication fluid with conductivity.

[Claim 2] Said conductive split is hydrodynamic bearing equipment according to claim 1 characterized by containing the same component as the quality of the material which is formed from \*\*\*\*\* which has the long side section to the thickness direction, and has said flexibility.

[Claim 3] Said conductive split is hydrodynamic bearing equipment according to claim 1 with which at least one side is characterized by including the thing of a dimension smaller than the dimension of the opposite clearance between said both dynamic pressure bearing surfaces.

[Claim 4] Said conductive split is hydrodynamic bearing equipment according to claim 1 characterized by the side section of a long dimension containing the thing of a larger dimension comparable as the dimension of the opposite clearance between said both dynamic pressure bearing surfaces or than it to the thickness direction.

[Claim 5] The shank material and bearing member which have been arranged so that relative rotation may be carried out, carrying out field opposite mutually, The dynamic pressure bearing surface formed in both the opposed faces of this shank material and a bearing member, respectively, In the hydrodynamic bearing equipment which has the dynamic pressure generating slot of both [ these ] the dynamic pressure bearing surfaces established in one side at least, and the lubrication fluid which is poured in into the opposite clearance between said both dynamic pressure bearing surfaces, and generates dynamic pressure according to a pressurization operation of the above-mentioned dynamic pressure generating slot While being formed with a conductive ingredient and formed from the quality of the material of said shank material and a bearing member in which the member of the one side of these shanks material and the bearing members has flexibility rather than the member of the other side, respectively Hydrodynamic bearing equipment characterized by carrying out specified quantity distribution of the processing \*\*\*\* of the member which becomes said lubrication fluid from the quality of the material which has the flexibility of the above-mentioned shank material and the bearing members so that the lubrication fluid concerned may be equipped with conductivity.

[Claim 6] The shank material and bearing member which have been arranged so that relative rotation may be carried out, carrying out field opposite mutually, The dynamic pressure bearing surface formed in both the opposed faces of this shank material and a bearing member, respectively, In the hydrodynamic bearing equipment which has the

dynamic pressure generating slot of both [ these ] the dynamic pressure bearing surfaces established in one side at least, and the lubrication fluid which is poured in into the opposite clearance between said both dynamic pressure bearing surfaces, and generates dynamic pressure according to a pressurization operation of the above-mentioned dynamic pressure generating slot While the member of the one side in which it was formed in with the conductive ingredient, and the above-mentioned dynamic pressure generating slot was established, respectively of said shank material and a bearing member is formed from the quality of the material which has flexibility rather than the member of the other side Hydrodynamic bearing equipment characterized by processing \*\*\*\* of a member in which said dynamic pressure generating slot was formed having the specified quantity for acquiring conductivity distributed by said lubrication fluid.

[Claim 7] Claim 1 characterized by said lubrication fluid consisting of a fluid which has insulation, 5, or hydrodynamic bearing equipment given in six.

[Claim 8] Said processing \*\*\*\* is hydrodynamic bearing equipment according to claim 5 or 6 with which at least one side is characterized by including the thing of a dimension smaller than the dimension of the opposite clearance between said both dynamic pressure bearing surfaces.

[Claim 9] Said processing \*\*\*\* is hydrodynamic bearing equipment according to claim 5 or 6 characterized by the side section which has the maximum length containing the thing of a comparable or larger dimension than the clearance dimension between said dynamic pressure bearing surfaces.

[Claim 10] Claim 1 characterized by a bearing member consisting of a copper system alloy while said shank material consists of stainless steel, 5, or hydrodynamic bearing equipment given in six.

[Claim 11] The shank material and bearing member which have been arranged so that relative rotation may be carried out, carrying out field opposite mutually, The dynamic pressure bearing surface formed in both the opposed faces of this shank material and a bearing member, respectively, The dynamic pressure generating slot of both [ these ] the dynamic pressure bearing surfaces established in one side at least, In the manufacture approach of hydrodynamic bearing equipment of having the lubrication fluid which is poured in into the opposite clearance between said both dynamic pressure bearing surfaces, and generates dynamic pressure according to a pressurization operation of the above-mentioned dynamic pressure generating slot While forming each of said shank material and a bearing member with a conductive ingredient While forming the member of the one side of these shanks material and the bearing members from the quality of the material which has flexibility rather than the member of the other side Make the front face of the flexibility member concerned carry out specified quantity survival of the processing \*\*\*\* of the member which consists of the quality of the material which has the flexibility of said shank material and the bearing members, and the above-mentioned processing \*\*\*\* is distributed in a lubrication fluid at the time of impregnation of said lubrication fluid. The manufacture approach of the hydrodynamic bearing equipment characterized by giving conductivity to the lubrication fluid concerned.

[Claim 12] The shank material and bearing member which have been arranged so that relative rotation may be carried out, carrying out field opposite mutually, The dynamic pressure bearing surface formed in both the opposed faces of this shank material and a bearing member, respectively, The dynamic pressure generating slot of both [ these ] the dynamic pressure bearing surfaces established in one side at least, In the manufacture approach of hydrodynamic bearing equipment of having the lubrication fluid which is

poured in into the opposite clearance between said both dynamic pressure bearing surfaces, and generates dynamic pressure according to a pressurization operation of the above-mentioned dynamic pressure generating slot While forming each of said shank material and a bearing member with a conductive ingredient While forming the member of the one side of these shanks material and the bearing members from the quality of the material which has flexibility rather than the member of the other side Make the front face of the member concerned carry out specified quantity survival of the processing \*\*\*\* at the time of processing of the member in which the dynamic pressure generating slot of said holddown member and the rotation members was formed, and the above-mentioned processing \*\*\*\* is distributed in a lubrication fluid at the time of impregnation of said lubrication fluid. The manufacture approach of the hydrodynamic bearing equipment characterized by giving conductivity to the lubrication fluid concerned.

[Claim 13] The manufacture approach of the hydrodynamic bearing equipment according to claim 11 or 12 characterized by forming said bearing member from a copper system alloy while forming said shank material from stainless steel.

[Claim 14] The manufacture approach of the hydrodynamic bearing equipment according to claim 11 or 12 characterized by using the lubricating oil which has insulation as said lubrication fluid.

[Claim 15] The manufacture approach of the hydrodynamic bearing equipment according to claim 11 or 12 characterized by making it make that from which at least one side of said piece of \*\*\*\*\* has a dimension smaller than the clearance dimension between said dynamic pressure bearing surfaces remain.

[Claim 16] The manufacture approach of the hydrodynamic bearing equipment according to claim 11 or 12 characterized by making it make the thing of a dimension with maximum

length's side section comparable as the clearance dimension between said dynamic pressure bearing surfaces, or large in said piece of \*\*\*\*\* remain.

[Claim 17] The manufacture approach of the hydrodynamic bearing equipment according to claim 16 characterized by making it make the piece of \*\*\*\*\* of said small dimension remain by cleaning ultrasonically after processing the member which makes said piece of \*\*\*\*\* remain.

## DETAILED DESCRIPTION

[Detailed Description of the Invention]

[0001]

[Field of the Invention] this invention -- the dynamic pressure of a predetermined lubrication fluid -- shank material and a bearing member -- relativity -- it is related with the hydrodynamic bearing equipment which was made to carry out bearing pivotable, and its manufacture approach.

[0002]

[Description of the Prior Art] The hydrodynamic bearing equipment which used the dynamic pressure of a lubrication fluid for carrying out high-speed rotation support of the various body of revolution, such as a magnetic disk, a polygon mirror, and an optical disk, in recent years etc. is being adopted, and development about the hydrodynamic bearing equipment is performed quickly. For example, the proposal about hydrodynamic bearing equipment equipped with the cure means for preventing electrification destruction of the MR head is variously made about the case where the magneto-resistive effect mold magnetic head (it is hereafter called an MR head) is adopted as an object for the formation of high density record of a magnetic disk.

[0003] While preparing a conductive bearing member and a conductive sleeve in hydrodynamic bearing equipment given in JP,7-6491,A, the charge generated by high-speed rotation of a magnetic disk is poured through a conductive lubrication fluid at a base side in the above-mentioned conductive bearing member and a sleeve, and a list, and he decreases the potential difference between a magnetic disk and the magnetic head by that cause, and is trying to prevent discharge by

using a conductive lubrication fluid as the example. At this time, the lubricating oil which gave the magnetic fluid and the special conductive additive is used as the above-mentioned conductive lubrication fluid.

[0004] Moreover, conductivity is secured with the means of arranging a magnetic fluid seal separately from a bearing member as other MR head electrification destructive prevention means, and what removed the unnecessary charge of a magnetic disk is proposed.

[0005]

[Problem(s) to be Solved by the Invention] however, like equipment before, by the thing using the lubricating oil which was mentioned above and which gave the magnetic fluid and the special conductive additive, the viscosity of a lubrication fluid goes up, or the physical properties of a lubrication fluid fall by the fall of thermal stability etc., and there is a problem that there may profit be no good bearing property. Moreover, in addition to it, it cannot but become expensive from using a very special lubricating oil.

[0006] Moreover, in the thing using a magnetic fluid seal, since a big attachment tooth space is needed, there is a problem that the whole equipment will be enlarged.

[0007] Then, this invention can attain a miniaturization by the simple and cheap configuration, and aims at offering the hydrodynamic bearing equipment which enabled it to acquire a good dynamic pressure property moreover, and its manufacture approach.

[0008]

[Means for Solving the Problem] In order to attain the above-mentioned purpose

with hydrodynamic bearing equipment according to claim 1 The shank material and bearing member which have been arranged so that relative rotation may be carried out, carrying out field opposite mutually, The dynamic pressure bearing surface formed in both the opposed faces of this shank material and a bearing member, respectively, In the hydrodynamic bearing equipment which has the dynamic pressure generating slot of both [ these ] the dynamic pressure bearing surfaces established in one side at least, and the lubrication fluid which is poured in into the opposite clearance between said both dynamic pressure bearing surfaces, and generates dynamic pressure according to a pressurization operation of the above-mentioned dynamic pressure generating slot While being formed with a conductive ingredient and formed from the quality of the material of said shank material and a bearing member in which the member of the one side of these shanks material and the bearing members has flexibility rather than the member of the other side, respectively The conductive split which has flexibility comparable as the quality of the material which has the above-mentioned flexibility is distributed by said lubrication fluid so that the lubrication fluid concerned may be equipped with conductivity.

[0009] Moreover, with hydrodynamic bearing equipment according to claim 2, the conductive split of the claim 1 above-mentioned publication is formed from \*\*\*\*\* which has the long side section to the thickness direction, and contains the same component as the quality of the material which has said flexibility.

[0010] Furthermore, with hydrodynamic bearing equipment according to claim 3, the conductive split of the claim 1 above-mentioned publication contains the thing of a dimension with at least one side smaller than the dimension of the

opposite clearance between said both dynamic pressure bearing surfaces.

[0011] With hydrodynamic bearing equipment according to claim 4, the conductive split of the claim 1 above-mentioned publication contains the thing of a dimension to the same extent as the dimension of the opposite clearance between said both dynamic pressure bearing surfaces with the larger side section of a long dimension than it to the thickness direction further again.

[0012] The shank material and bearing member which have been arranged so that relative rotation may be carried out with hydrodynamic bearing equipment according to claim 5 on the other hand, carrying out field opposite mutually, The dynamic pressure bearing surface formed in both the opposed faces of this shank material and a bearing member, respectively, In the hydrodynamic bearing equipment which has the dynamic pressure generating slot of both [ these ] the dynamic pressure bearing surfaces established in one side at least, and the lubrication fluid which is poured in into the opposite clearance between said both dynamic pressure bearing surfaces, and generates dynamic pressure according to a pressurization operation of the above-mentioned dynamic pressure generating slot While being formed with a conductive ingredient and formed from the quality of the material of said shank material and a bearing member in which the member of the one side of these shanks material and the bearing members has flexibility rather than the member of the other side, respectively Specified quantity distribution of the processing \*\*\*\* of the member which consists of the quality of the material which has the flexibility of the above-mentioned shank material and the bearing members is carried out so that the lubrication fluid concerned may equip said lubrication fluid with conductivity.

[0013] Moreover, the shank material and bearing member which have been arranged so that relative rotation may be carried out with hydrodynamic bearing equipment according to claim 6, carrying out field opposite mutually, The dynamic pressure bearing surface formed in both the opposed faces of this shank material and a bearing member, respectively, In the hydrodynamic bearing equipment which has the dynamic pressure generating slot of both [ these ] the dynamic pressure bearing surfaces established in one side at least, and the lubrication fluid which is poured in into the opposite clearance between said both dynamic pressure bearing surfaces, and generates dynamic pressure according to a pressurization operation of the above-mentioned dynamic pressure generating slot While the member of the one side in which it was formed in with the conductive ingredient, and the above-mentioned dynamic pressure generating slot was established, respectively of said shank material and a bearing member is formed from the quality of the material which has flexibility rather than the member of the other side [0014] which is having the specified quantity for processing \*\*\*\* of a member in which said dynamic pressure generating slot was formed to acquire conductivity distributed by said lubrication fluid Furthermore, with hydrodynamic bearing equipment according to claim 7, a lubrication fluid above-mentioned claim 1, 5, or given in six consists of a fluid which has insulation.

[0015] As for hydrodynamic bearing equipment according to claim 8, processing \*\*\*\* above-mentioned claim 5 or given in six contains the thing of a dimension with at least one side smaller than the dimension of the opposite clearance between said both dynamic pressure bearing surfaces further again.

[0016] On the other hand, hydrodynamic bearing equipment according to claim 9 contains the thing of a dimension that said processing \*\*\*\* according to claim 5 or 6 has the side section more nearly comparable than the clearance dimension between said dynamic pressure bearing surfaces which has the maximum length, or large.

[0017] Moreover, with hydrodynamic bearing equipment according to claim 10, while shank material said claim 1, 5, or given in six consists of stainless steel, a bearing member consists of a copper system alloy.

[0018] furthermore, by the manufacture approach of hydrodynamic bearing equipment according to claim 11 The shank material and bearing member which have been arranged so that relative rotation may be carried out, carrying out field opposite mutually, The dynamic pressure bearing surface formed in both the opposed faces of this shank material and a bearing member, respectively, The dynamic pressure generating slot of both [ these ] the dynamic pressure bearing surfaces established in one side at least, In the manufacture approach of hydrodynamic bearing equipment of having the lubrication fluid which is poured in into the opposite clearance between said both dynamic pressure bearing surfaces, and generates dynamic pressure according to a pressurization operation of the above-mentioned dynamic pressure generating slot While forming each of said shank material and a bearing member with a conductive ingredient While forming the member of the one side of these shanks material and the bearing members from the quality of the material which has flexibility rather than the member of the other side The front face of the flexibility member concerned is made to carry out specified quantity survival of the processing \*\*\*\* of the

member which consists of the quality of the material which has the flexibility of said shank material and the bearing members, and he distributes the above-mentioned processing \*\*\*\* in a lubrication fluid, and is trying to give conductivity to the lubrication fluid concerned at the time of impregnation of said lubrication fluid.

[0019] Further again by the manufacture approach of hydrodynamic bearing equipment according to claim 12 The shank material and bearing member which have been arranged so that relative rotation may be carried out, carrying out field opposite mutually, The dynamic pressure bearing surface formed in both the opposed faces of this shank material and a bearing member, respectively, The dynamic pressure generating slot of both [ these ] the dynamic pressure bearing surfaces established in one side at least, In the manufacture approach of hydrodynamic bearing equipment of having the lubrication fluid which is poured in into the opposite clearance between said both dynamic pressure bearing surfaces, and generates dynamic pressure according to a pressurization operation of the above-mentioned dynamic pressure generating slot While forming each of said shank material and a bearing member with a conductive ingredient While forming the member of the one side of these shanks material and the bearing members from the quality of the material which has flexibility rather than the member of the other side The front face of the member concerned is made to carry out specified quantity survival of the processing \*\*\*\* at the time of processing of the member in which the dynamic pressure generating slot of said holddown member and the rotation members was formed, and he distributes the above-mentioned processing \*\*\*\* in a lubrication fluid, and is trying to give

conductivity to the lubrication fluid concerned at the time of impregnation of said lubrication fluid.

[0020] Furthermore, while forming said shank material according to claim 11 or 12 from stainless steel, he is trying to form said bearing member from a copper system alloy by the manufacture approach of hydrodynamic bearing equipment according to claim 13.

[0021] He is trying for above-mentioned claim 11 to use the lubricating oil which has insulation as a lubrication fluid given in 12 by the manufacture approach of hydrodynamic bearing equipment according to claim 14 further again.

[0022] He is trying for at least one side of said piece of \*\*\*\*\* according to claim 11 or 12 to, make the thing used as a dimension smaller than the clearance dimension between said dynamic pressure bearing surfaces remain by the manufacture approach of hydrodynamic bearing equipment according to claim 15 on the other hand.

[0023] Moreover, he is trying for maximum length's side section in said piece of \*\*\*\*\* according to claim 11 or 12 to make the thing of a dimension comparable as the clearance dimension between said dynamic pressure bearing surfaces, or large remain by the manufacture approach of hydrodynamic bearing equipment according to claim 16.

[0024] Moreover, he is trying to make the piece of \*\*\*\*\* of said small dimension remain by the manufacture approach of hydrodynamic bearing equipment according to claim 17 by cleaning ultrasonically after processing the member which makes said piece of \*\*\*\*\* according to claim 16 remain.

[0025] As opposed to the lubrication fluid which has the cheap and good bearing

property of generally being used, like such invention according to claim 1 The conductive split which consists of \*\*\*\*\* which has flexibility comparable as the member which has flexibility is distributed. Since the lubrication fluid which gave conductivity is poured in and used by it into the bearing clearance between the shank material and bearing members which consist of a conductive ingredient A good dynamic pressure property is acquired it becoming unnecessary to use a conductive special lubrication fluid like before to which it is expensive and has a difficulty in a bearing property, and a large-sized magnetic fluid seal consequently, and attaining the simplification and a miniaturization of a configuration.

[0026] If the same component as the quality of the material of the member which has flexibility for the conductive split which consists of \*\*\*\*\* like invention according to claim 2 at this time shall be contained, it is lost that the conductive split which consists of \*\*\*\*\* damages shank material and a bearing member, and reinforcement of equipment will be attained while a smooth rotation property is acquired.

[0027] Moreover, if at least one side of a conductive split carries out to including the thing of a dimension smaller than the dimension of a bearing clearance like invention according to claim 3, while orientation of the conductive split in the above-mentioned bearing clearance is carried out in the direction with little resistance, it moves freely, and in the clearance between the dynamic pressure bearing surfaces, it will become easy to rotate easily and damage on shank material or a bearing member will be reduced further.

[0028] Furthermore, if the long side of a conductive split carries out to including

what of a larger dimension than it is comparable as the dimension of a bearing clearance like invention according to claim 4, the contact frequency to the wall section of the above-mentioned bearing clearance will be raised, and good conductivity will be acquired.

[0029] Furthermore, a lubrication fluid is made to distribute processing \*\*\*\* of the shank material or bearing member which consists of a conductive ingredient like invention according to claim 5, 6, 11, or 12. If the lubrication fluid which gave conductivity is poured in into the bearing clearance between the above-mentioned shank material and a bearing member and is used by it A good dynamic pressure property is acquired it becoming unnecessary to use a conductive special lubrication fluid like before to which it is expensive and has a difficulty in a bearing property, and a large-sized magnetic fluid seal, and attaining the simplification and a miniaturization of a configuration.

[0030] At this time, like invention according to claim 7 or 14, it is cheap, and if the insulating lubrication fluid excellent in the bearing property is used, much more low cost-ization will be attained.

[0031] Moreover, if at least one side of a conductive split carries out to including the thing of a dimension smaller than the dimension of a bearing clearance like invention according to claim 8 or 15, while orientation of the conductive split in the above-mentioned bearing clearance is carried out in the direction with little resistance, it moves freely, and in the clearance between the dynamic pressure bearing surfaces, it will become easy to rotate easily and damage on shank material or a bearing member will be reduced further.

[0032] Furthermore, if the long side of a conductive split carries out to including

what of a larger dimension than it is comparable as the dimension of a bearing clearance like invention according to claim 9 or 16, the contact frequency to the wall section of the above-mentioned bearing clearance will be raised, and conductivity will be acquired certainly.

[0033] Furthermore, if the bearing member is constituted from a copper system alloy like invention according to claim 10 or 13 while constituting shank material from stainless steel, the fundamental structure of hydrodynamic bearing equipment will be made by the usual simple configuration.

[0034] Like invention according to claim 17, if only the comparatively big dimension which is easy to damage shank material and a bearing member by performing ultrasonic cleaning after processing is removed, it is hard to damage shank material and a bearing member, for example, only the piece of \*\*\*\*\* of very small magnitude which has the thickness of about 1 micrometer or less remains efficiently on the front face of a workpiece-ed further again.

[0035]

[Embodiment of the Invention] Hereafter, although the gestalt of operation of this invention is explained, in advance of it, the whole hard-disk-drive (HDD) structure which applies this invention is explained based on the drawing.

[0036] The whole HDD spindle motor of the axial rotation shown in drawing 1 consists of a stator group 10 as a holddown member, and a Rota group 20 as a rotation member attached from the illustration bottom to the stator group 10. Among these, the stator group 10 has the fixed frame 11 by which the screw stop was carried out to the fixed pedestal side which omitted illustration. Although this fixed frame 11 is formed from the aluminum system metallic material in

order to attain lightweight-ization, the bearing sleeve 13 as a fixed bearing member formed in the bell shape is joined to the above-mentioned bearing electrode holder 12 by press fit or shrinkage fit at the inner circumference side of the annular bearing electrode holder 12 formed in it as set up into the abbreviation central part of the fixed frame 11 concerned. This bearing sleeve 13 is formed from copper system alloy ingredients, such as phosphor bronze, in order to easy-ize hole processing of a minor diameter etc.

[0037] Moreover, the stator core 14 which consists of a layered product of a magnetic steel sheet is attached in the periphery clamp face of said bearing electrode holder 12. The drive coil 15 is wound around each salient pole section prepared in this stator core 14, respectively.

[0038] Furthermore, into the feed hole established in the above-mentioned bearing sleeve 13, the revolving shaft 21 which constitutes the Rota group 20 mentioned above is inserted free [ rotation ]. The revolving shaft 21 in this operation gestalt is formed from predetermined stainless steel. That is, the bearing sleeve 13 as said bearing member is formed rather than the above-mentioned revolving shaft 21 as shank material from the quality of the material which has flexibility.

[0039] And the dynamic pressure side formed in the inner circle wall section of the above-mentioned bearing sleeve 13 is arranged so that it may counter radial to the dynamic pressure side formed in the peripheral face of the above-mentioned revolving shaft 21, and the radial dynamic pressure bearing RB is constituted by the part of the minute bearing clearance. More, the lubrication fluid with which the dynamic pressure side by the side of the bearing sleeve 13 in

the above-mentioned radial dynamic pressure bearing RB and the dynamic pressure side by the side of a revolving shaft 21 have the presentation to which it mentions later in the bearing space which opposite arrangement is carried out at the shape of a periphery, and consists of the very small clearance through a several micrometers very small clearance is poured in at the detail so that shaft orientations may be followed.

[0040] Both the dynamic pressure side of the above-mentioned bearing sleeve 13 and a revolving shaft 21 at least furthermore, to one side It passes. For example, it omitted illustration, the slot for radial dynamic pressure generating of a ring bone configuration It is divided into 2 blocks by shaft orientations, and the groove is annularly cut in them, and the above-mentioned lubrication fluid is pressurized by pumping operation of the slot for radial dynamic pressure generating concerned at the time of rotation, and dynamic pressure is produced. With the dynamic pressure of the lubrication fluid The rotating hub 22 later mentioned with said revolving shaft 21 is made by the configuration that axial support is carried out in the radial direction.

[0041] On the other hand, the capillary tube seal section RS is arranged at the illustration upper limit part of the bearing space which constitutes each above-mentioned radial dynamic pressure bearing RB. Of the inclined plane formed in the above-mentioned revolving-shaft 21 or bearing-sleeve 13 side, this capillary tube seal section RS consists of a configuration of having expanded gradually the bearing clearance mentioned above toward the method side of the outside of bearing, and is formed in the clearance dimension of 20 to 300 micrometers. It is made in this capillary tube seal section RS by the configuration

that the oil level of a lubrication fluid is located in the case of which [ of rotation and a halt of a motor ].

[0042] Furthermore, the rotating hub 22 which constitutes the Rota group 20 with the above-mentioned revolving shaft 21 consists of an abbreviation cup-like member which consists of an aluminum system metal so that record media, such as a magnetic disk which omitted illustration, may be carried, and 22d of junction holes prepared by the core of the rotating hub 22 concerned is joined by press fit or eye a thermal insert in one to the illustration upper limit part of the above-mentioned revolving shaft 21.

[0043] While the above-mentioned rotating hub 22 has approximately cylindrical drum section 22a which carries a record-medium disk in the periphery section, ring-around magnet 22c is attached in the inner circle wall side side of the illustration bottom of this drum section 22a through back yoke 22b. Contiguity arrangement of this ring-around magnet 22c is carried out so that it may counter annularly to the periphery side edge side of the stator core 14 mentioned above.

[0044] On the other hand, the disc-like thrust plate 23 has fixed to a part for the point by the side of the illustration lower limit of said revolving shaft 21. This thrust plate 23 is held in the hollow circles of the shape of a cylinder cut in a part for the core by the side of the illustration lower limit of the bearing sleeve 13 mentioned above, and is made and arranged, and in the hollow circles of that bearing sleeve 13, to the dynamic pressure side established in the bearing sleeve 13, opposite arrangement of the dynamic pressure side established in the illustration top side of the thrust plate 23 concerned is carried out so that shaft

orientations may be approached. And among both those opposite dynamic pressure sides, at least, the dynamic pressure generating slot which has a proper configuration is formed in one side, and the upper thrust dynamic pressure bearing SBa is formed in the opposite clearance part of these thrust plates 23 and both the dynamic pressure sides of a bearing sleeve 13.

[0045] As the dynamic pressure side of the illustration bottom of the above-mentioned thrust plate 23 is approached, the counter plate 16 which consists of a disc-like member of a major diameter comparatively is arranged further again. The lower thrust dynamic pressure bearing SBb is formed by this counter plate's 16 fixing so that the lower limit side opening part of the above-mentioned bearing sleeve 13 may be blockaded, and forming the dynamic pressure generating slot which has a proper configuration also into the contiguity opposite clearance part between the dynamic pressure side established in the illustration top-face side of the counter plate 16 concerned, and the dynamic pressure side of the illustration bottom of the thrust plate 23 mentioned above.

[0046] Both the dynamic pressure side by the side of the thrust plate 23 which constitutes the thrust dynamic pressure bearings SBa and SBb of the lot which adjoined shaft orientations and has been arranged as mentioned above, With both the dynamic pressure side by the side of the bearing sleeve 13 which counters it, and a counter plate 16 While opposite arrangement is carried out through the several micrometers very small clearance at shaft orientations, respectively, the lubrication fluid which has the presentation mentioned later is poured in into the bearing space which consists of the very small clearance so that shaft orientations may be followed through the periphery side path of said

thrust plate 23.

[0047] As the dynamic pressure side of the above-mentioned thrust plate 23, and a bearing sleeve 13 and the dynamic pressure side of a counter plate 16, at least furthermore, to one side Omitted and pass through illustration, and the slot for thrust dynamic pressure generating of a ring bone configuration is divided into 2 blocks by radial, and is annularly cut in it. The above-mentioned lubrication fluid is pressurized by pumping operation of the slot for thrust dynamic pressure generating concerned at the time of rotation, dynamic pressure is produced, and the revolving shaft 21 and rotating hub 22 which were mentioned above with the dynamic pressure of the lubrication fluid are made in the thrust direction by the configuration by which axial support is carried out.

[0048] Here, as mentioned above, the bearing sleeve 13 of said stator group 10 and the revolving shaft 21 of the Rota group 20 are formed, respectively from the stainless steel and phosphor bronze (copper system alloy) which are the ingredient which has conductivity, and have flexibility rather than the revolving shaft 21 whose direction of the quality of the material of the bearing sleeve 13 as a bearing member is shank material. And processing \*\*\*\* when finish-machining the inner circumference front face of the bearing sleeve 13 which has this flexibility is distributed in the lubrication fluid mentioned above.

[0049] That is, while the above-mentioned lubrication fluid A contains the insulating lubricating oil which consists of the ester oil and the hydrocarbon system (the Pori alpha olefin, mineral oil) which have the insulation of  $1 \times 10$  to  $12$  or more ohm-cm of volume resistivities, an ether system, a fluorine system, etc. as distributed base oil material A1 of the lubrication fluid A concerned, much

processing \*\*\*\* A2 of the bearing sleeve 13 mentioned above in the insulating distributed base oil material A1 are distributed as shown in drawing 2 . And conductivity is given to the above-mentioned lubrication fluid A by those distributed processing \*\*\*\* A2.

[0050] Although it remains on those processing front faces when processing \*\*\*\* A2 of the above-mentioned bearing sleeve 13 finishes the inner circle wall side of a bearing sleeve 13 from the first at this time, or when forming of rolling of the dynamic pressure generating slot is carried out Processing \*\*\*\* A2 on the above-mentioned bearing sleeve 13 is arranged by carrying out natural distribution into the insulating lubricating oil A1 in a bearing clearance at the same time it pours in the distributed base oil material A1 of the insulating lubricating oil A mentioned above at the time of the assembly of a motor into a bearing clearance.

[0051] That is, in the processing process of said bearing sleeve 13, penetration formation of the bearing hole which has a bore with a bore of 2.998mm is first carried out to the material of the above-mentioned bearing sleeve 13, and plastic working of the dynamic pressure generating slot with a depth of about 8 micrometers is carried out using a ball rolling tool etc. to the inner circle wall side of the bearing hole of the bearing-sleeve material. In the front face of this dynamic pressure generating slot by which plastic working was carried out, processing \*\*\*\* A2 mentioned above remains. Subsequently, to the inner circle wall side of the bearing hole of the above-mentioned bearing-sleeve material, similarly bore processing with a bore of 2.998mm is performed, and ridges, such as weld flash generated by it at the time of plastic working of the

above-mentioned dynamic pressure generating slot, are removed. And finish-machining by 3.000mm, i.e., cutting in a 1-micrometer machining allowance, is performed for the bore of the above-mentioned bearing hole after that. On the front face of this bearing-sleeve material that it finish-machined, processing \*\*\*\* containing processing \*\*\*\* A2 with a thickness of about 1 micrometer remains.

[0052] Furthermore, after ending a processing process which was mentioned above, ultrasonic cleaning of the front face of a bearing-sleeve material is carried out using a predetermined solvent and water. Generally, although the elimination factor of a particle with comparatively big ultrasonic cleaning is high, the elimination factor to an about 1-micrometer small adhesion particle is bad. Therefore, on the front face of the bearing-sleeve material after the ultrasonic-cleaning process mentioned above, only processing \*\*\*\* A2 which consists of a conductive split which has the minute thickness of 1 micrometer or less will remain, and larger processing \*\*\*\* than it will be removed.

[0053] At this time, processing \*\*\*\* A2 which consists of the above-mentioned conductive split As it mainly has a configuration corresponding to cutting in the 1-micrometer machining allowance mentioned above and is shown in drawing 3 It is formed in \*\*\*\*\* which has the long side section to thickness, such as an outline disc-like configuration (a), needlelike configuration (b), and sheet metal-like configuration (c), and the thickness of the \*\*\*\*\* is formed in 1 micrometer or less. Moreover, the thing used as a dimension with at least one side smaller than the bearing-clearance dimension between the bearing sleeves 13 and revolving shafts 21 which were mentioned above (for example, 3-5

micrometers) in each \*\*\*\* of the above-mentioned piece-like object is contained in this processing \*\*\*\* A2, and by carrying out orientation in the direction with little resistance into the above-mentioned bearing clearance, it is constituted so that it can move freely.

[0054] Moreover, in processing \*\*\*\* A2 mentioned above, the thing of a dimension to the same extent as said bearing-clearance dimension (3-5 micrometers) with the larger long side section than it is contained to the thickness direction as expressed with sign A2' in drawing 4 . When processing \*\*\*\* A2' which has these long side sections contains above-mentioned processing \*\*\*\* A2' from the contact frequency to the wall section of the above-mentioned bearing clearance being raised so that it may mention later, conductivity is acquired certainly.

[0055] This operation gestalt at thus, the time of impregnation of the distributed base oil material A1 which has the cheap and good bearing property of generally being used and which is an insulating lubrication fluid The conductive split A2 which consists of processing \*\*\*\* of a bearing sleeve 13 which has flexibility, i.e., \*\*\*\*\*, by making it distribute in the above-mentioned insulating lubrication fluid A1 It considers as the lubrication fluid A which has conductivity, and the lubrication fluid A to which the conductivity was given is used into the bearing clearance formed between the revolving shafts 21 and bearing sleeves 13 which consist of a conductive ingredient. Although the conductive split A2 which consists of \*\*\*\*\* which is processing \*\*\*\* of the bearing sleeve 13 mentioned above at this time will move about the inside of a bearing clearance freely in accordance with the flow of a lubrication fluid and will repeat contact and alienation to each front face of the above-mentioned revolving shaft 21 and a

bearing sleeve 13 for example, the conductive split A2 which consists of the \*\*\*\*\* one or more as shown in drawing 2 It will be in a contact condition which connects the front face by the side of said revolving shaft 21, and the front face by the side of a bearing sleeve 13. The charge which an above-mentioned revolving-shaft 21 and bearing-sleeve 13 side is electrically connected by it, consequently is generated by high-speed rotation of a magnetic disk etc. will be discharged, the potential difference between a magnetic disk and the magnetic head will decrease, and discharge will be prevented.

[0056] The electric connection condition between such revolving shafts 21 and bearing sleeves 13 can be checked by measuring the temporal response of the electric resistance between both the members 21 mentioned above and 13 as shown in drawing 5 . Namely, drawing 3 measures the electric resistance between the Rota-stators when setting rotational speed to 7200rpm based on the potential difference. In the case of the non-switch-on which has the resistance which exceeds 10 M omega you to be Haruka, the potential difference between both the above-mentioned members 21 and 13 (axis of ordinate) is about 5V, but With the equipment concerning the operation gestalt mentioned above, it is changing to zero potential frequently with progress of time amount (axis of abscissa), and if it averages, it is the resistance of several M omega. Generally, in order to have avoided the electrification trouble, it was actually confirmed that it is checked that what is necessary is just the resistance of about 10 M omega or less, therefore the above-mentioned revolving shaft 21 and the bearing sleeve 13 have flowed good in this operation gestalt.

[0057] Therefore, according to this operation gestalt, while it is necessary to use

neither a conductive special lubrication fluid like before to which it is expensive and has a difficulty in a bearing property, nor a large-sized magnetic fluid seal and the configuration of the whole equipment is simplified and miniaturized, a good dynamic pressure property is acquired. As a result of performing a sliding reliability trial, printing, wear, and other performance-problem points were not actually accepted.

[0058] Reinforcement of equipment is attained, while it is lost that the conductive split A2 which consists of \*\*\*\*\* damages a revolving shaft 21 and a bearing sleeve 13 since the conductive split A2 which consists of \*\*\*\*\* is formed from the same quality of the material as the bearing sleeve 13 which has flexibility and a smooth rotation property is especially acquired with this operation gestalt.

[0059] In addition, since what made at least one side in each \*\*\*\* of the conductive split A2 which consists of \*\*\*\*\* the dimension smaller than the dimension of the bearing clearance between the dynamic pressure bearing surfaces with this operation gestalt is included, as shown by the arrow head of drawing 3 According to an easy rotation operation of the conductive split A2 which the conductive split A2 which consists of the above-mentioned piece-like object will rotate immediately after contacting a revolving-shaft 21 or bearing-sleeve 13 side, and it turns into from such \*\*\*\*\* The damage to a revolving-shaft 21 side or a bearing sleeve 13 is reduced much more certainly.

[0060] Furthermore, when the thing of a larger, conductive split A2', i.e., a long side, as shown in drawing 4 , dimension to the same extent as the dimension twist of the bearing clearance between the dynamic pressure bearing surfaces than it is included, the contact frequency to the wall section of the revolving shaft

21 which constitutes the above-mentioned bearing clearance, or a bearing sleeve 13 is raised, and good conductivity is acquired certainly.

[0061] It is cheap to that the fundamental structure of hydrodynamic bearing equipment is made by the usual simple configuration since the revolving shaft 21 and the bearing sleeve 13 are formed from common ingredients, such as stainless steel and phosphor bronze, with this operation gestalt further again, and the distributed base material A1 of the above-mentioned lubrication fluid A, and much more low cost-ization is attained from using the insulating lubricating oil excellent in the bearing property.

[0062] With this operation gestalt, in addition, by performing ultrasonic cleaning after processing of a bearing sleeve 13 Processing \*\*\*\* of a comparatively big dimension which is easy to damage a revolving shaft 21 and a bearing sleeve 13 is removed. For example, he is trying to make only the piece of \*\*\*\*\* of very small magnitude which has the thickness of about 1 micrometer or less remain on the front face of a bearing sleeve 13, and selection of minute processing \*\*\*\* A2 so that a revolving shaft 21 and a bearing sleeve 13 may be made hard to damage is performed very efficiently.

[0063] As mentioned above, although the operation gestalt of invention made by this invention person was explained concretely, it cannot be overemphasized that this invention is moderately deformable in the range which is not limited to the above-mentioned operation gestalt and does not deviate from the summary.

[0064] For example, although the conductive split A2 which consists of \*\*\*\*\* is made into the same quality of the material as a bearing sleeve 13 with the operation gestalt mentioned above and the quality of the materials itself differ,

the quality of the material which contains in a part the ingredient which has flexibility comparable as the bearing sleeve 13 which has flexibility, and what has comparable flexibility and a bearing sleeve 13 can also be adopted similarly. moreover, the conductive split A2 which consists of \*\*\*\*\* -- flexibility not necessarily comparable as the bearing sleeve 13 as a bearing member -- it is not necessary to have -- either shank material or the bearing members -- what is necessary is just to have flexibility comparable as the member of the direction which has flexibility

[0065] Moreover, the spherical particle may be included in the conductive split A2 which consists of \*\*\*\*\* in the operation gestalt mentioned above. Furthermore, the distributed base oil material A1 of a lubrication fluid may not necessarily be \*\* which has insulation.

[0066] This invention can be similarly applied further again to the hydrodynamic bearing equipment of a different axial cover half from an axial rotation mold like the operation gestalt mentioned above.

[0067] Moreover, the hydrodynamic bearing equipment concerning this invention is applicable similarly to the hydrodynamic bearing equipment used in addition to a motor for HDD like the operation gestalt mentioned above, for example, the hydrodynamic bearing equipment used for the motor for a polygon mirror drive, or the motor for a CD-ROM drive.

[0068]

[Effect of the Invention] As opposed to the lubrication fluid which has the cheap and good bearing property that generally this invention is used as stated above By pouring in and using what distributed the conductive split which consists of

\*\*\*\*\* which has flexibility comparable as the member which has flexibility into the bearing clearance between the shank material and bearing members which consist of a conductive ingredient The remarkable effectiveness that a good dynamic pressure property can be acquired is done so, attaining the simplification and a miniaturization of a configuration, since a conductive special lubrication fluid like before to which it is expensive and has a difficulty in a bearing property, and the need of using a large-sized magnetic fluid seal are abolished.

[0069] As a thing containing the same component as the quality of the material of the member which has flexibility for the conductive split which invention according to claim 2 becomes from \*\*\*\*\* at this time, it abolishes that the conductive split which consists of \*\*\*\*\* damages shank material and a bearing member, and since reinforcement of equipment is attained while acquiring a smooth rotation property, the effectiveness mentioned above can be raised further.

[0070] Moreover, since invention according to claim 3 reduces damage on shank material or a bearing member further as freely movable in the conductive split in the above-mentioned bearing clearance when at least one side of a conductive split contains the thing of a dimension smaller than the dimension of a bearing clearance, it can heighten further the effectiveness mentioned above.

[0071] Furthermore, since invention according to claim 4 raises the contact frequency to the wall section of the above-mentioned bearing clearance and acquires good conductivity certainly by including the thing of a dimension to the same extent as the dimension of a bearing clearance with the larger long side of a

conductive split than it, it can raise further the effectiveness mentioned above.

[0072] Furthermore, invention according to claim 5, 6, 11, or 12 By pouring in and using the thing which made the lubrication fluid distribute processing \*\*\*\* of the shank material or bearing member which consists of a conductive ingredient into the bearing clearance between the above-mentioned shank material and a bearing member The remarkable effectiveness that a good dynamic pressure property can be acquired is done so, attaining the simplification and a miniaturization of a configuration, since a conductive special lubrication fluid like before to which it is expensive and has a difficulty in a bearing property, and the need of using a large-sized magnetic fluid seal are abolished.

[0073] Since it constitutes so that much more low cost-ization may be attained by using the insulating lubrication fluid which whose invention according to claim 7 or 14 was cheap at this time, and was excellent in the bearing property, the effectiveness mentioned above can be raised further.

[0074] Moreover, since invention according to claim 8 or 15 reduces damage on shank material or a bearing member further as freely movable in the conductive split in the above-mentioned bearing clearance when at least one side of a conductive split includes the thing of a dimension smaller than the dimension of a bearing clearance, it can heighten further the effectiveness mentioned above.

[0075] Furthermore, since the contact frequency to the wall section of the above-mentioned bearing clearance is raised and conductivity is certainly acquired like invention according to claim 9 or 16 by including the thing of a dimension to the same extent as the dimension of a bearing clearance with the

larger long side of a conductive split than it, the effectiveness mentioned above can be raised further.

[0076] Furthermore, since invention according to claim 10 or 13 constitutes a bearing member from a copper system alloy and considers fundamental structure of hydrodynamic bearing equipment as the usual simple configuration while it constitutes shank material from stainless steel, it can raise further the effectiveness mentioned above.

[0077] Invention according to claim 17 by performing ultrasonic cleaning after processing further again Only the comparatively big dimension which is easy to damage shank material and a bearing member is removed, and it is hard to damage shank material and a bearing member. For example, since it is made to make only the piece of \*\*\*\*\* of very small magnitude which has the thickness of about 1 micrometer or less remain efficiently on the front face of a workpiece-ed, the effectiveness mentioned above can be raised further.

## DESCRIPTION OF DRAWINGS

### [Brief Description of the Drawings]

[Drawing 1] It is a longitudinal-section explanatory view showing the whole hard-disk-drive (HDD) example of structure equipped with the hydrodynamic bearing equipment of the axial rotation mold concerning 1 operation gestalt of this invention.

[Drawing 2] It is the cross-section explanatory view which expanded and expressed the bearing clearance of the hydrodynamic bearing equipment shown in drawing 1 .

[Drawing 3] It is the cross-section explanatory view which expanded and expressed other examples of processing \*\*\*\* contained in the bearing clearance of hydrodynamic bearing equipment.

[Drawing 4] It is an appearance strabism explanatory view showing the example of a configuration of processing \*\*\*\* A2 and A2' included in the lubrication fluid A.

[Drawing 5] It is the diagram which measured time amount (axis of abscissa)-change of the potential between shank material and a bearing member (axis of ordinate).

[Description of Notations]

10 Stator Group (Holddown Member)

13 Bearing Sleeve (Bearing Member)

20 Rota Group (Rotation Member)

21 Revolving Shaft

22 Rotating Hub

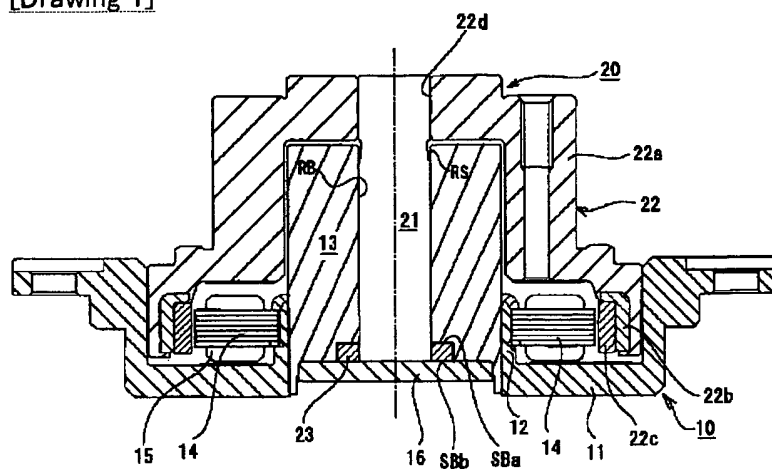
A Lubrication fluid

A1 Distributed base oil material

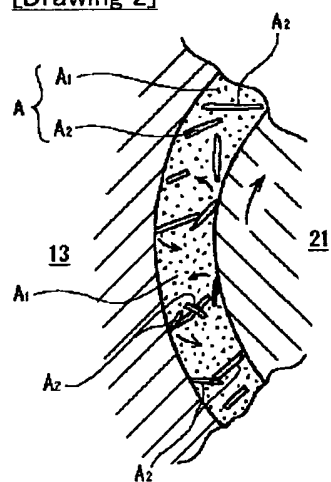
A2, A2' Processing \*\*\*\*

## DRAWINGS

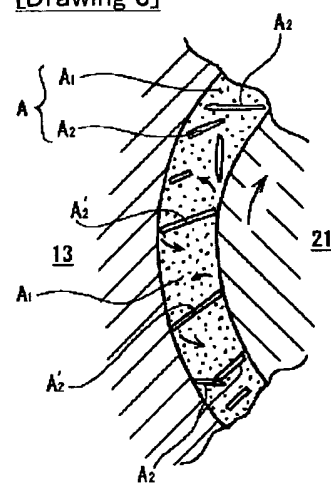
[Drawing 1]



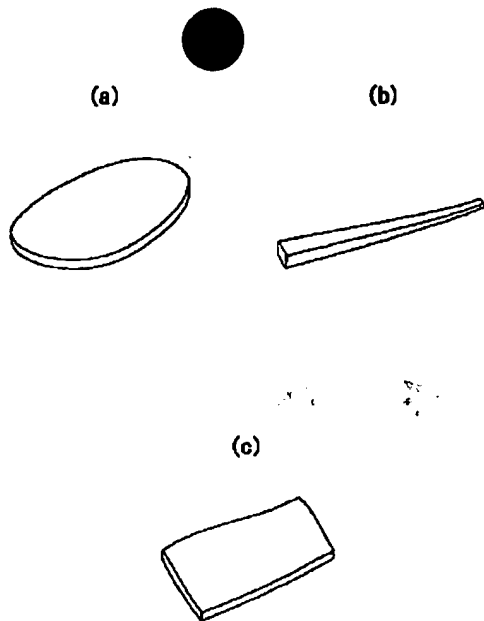
[Drawing 2]



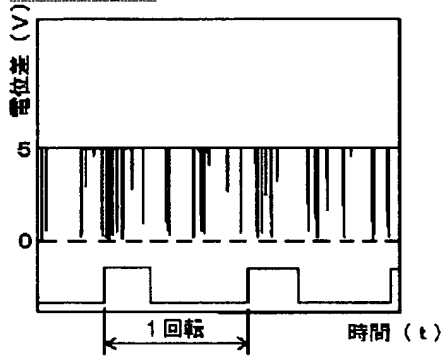
[Drawing 3]



[Drawing 4]



[Drawing 5]



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